



Re-tuning  
Commercial  
Buildings



# Building Re-tuning Training

Transforming Commercial Building  
Operations

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- Most buildings are not commissioned (Cx) before occupancy, including HVAC and lighting systems
- Buildings often are poorly operated and maintained leading to significant energy waste of 5 to 20%, even when they have building automation systems (BASs)
- Retro-commissioning (RCx) improves operations and reduces energy use but is perceived in the market as both costly (not always true) and as not delivering persistent savings (often true)
- Lack of sufficiently trained workforce also makes it difficult to scale-up RCx
- Most existing building operator training programs do not adequately train on “how to” operate buildings efficiently

# Solution: Building Re-tuning Training can Fill the Gap

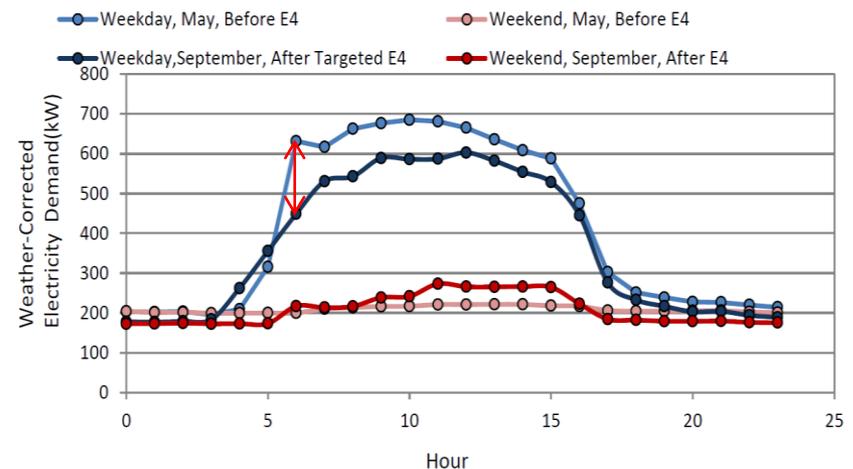
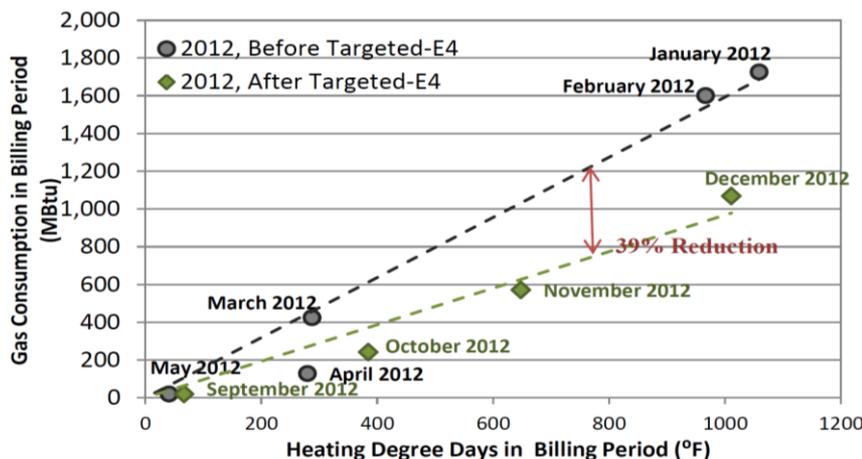
- Re-tuning Training - Train building operations staff and service providers in a systematic process to identify and correct no-cost and low-cost building operational problems that (if left uncorrected) lead to energy waste but at a fraction of the RCx cost
- **Re-tuning training is a unique solution:** classroom and field
  - Fills an existing gap in the training programs (how to.....)
  - Teaches building operators **how to** identify operational problems but also more importantly **how to** correct them
  - Once staff are trained to re-tune buildings, cost and persistence issues are addressed
  - For buildings with BAS, re-tuning leverages information from BAS to identify operational problems and improvements
  - Typically no cost other than labor required to perform
  - May include no-cost and low-cost repairs, such as replacing faulty sensors
  - For buildings without BAS, re-tuning teaches a prescriptive approach to identify and correct operational problems



- **Near-term:** Achieving a vision in which overall building operating costs are lower and asset valuation is higher by
  - increasing knowledge about re-tuning amongst in-house building operations staff and RCx service providers
  - training next generation of building efficiency work force
  - widely disseminating re-tuning training approach (low-cost, simple methods on how to retune)
- **Long-term:** Automating the identification and correction of re-tuning measures
- One of the major goals of the President's Plan on Better Buildings is to address the need to provide workforce training in energy auditing and building operations

# Potential Project Impact

- Commercial building energy consumption is over 18 Quadrillion BTUs annually
- As much as 30% of this energy consumption is wasted because of our inability to operate the buildings efficiently
- Train building managers and operations staff on how to identify and correct operational problems as they arise, rather than years later
- Re-tuning training will result in a **proactive** and more efficient building operations at very little cost to the building owner/manager
- Transformation will occur by developing trainers who will be responsible for training the current and the next generation of building operations workforce
- It will also address the shortage in availability of skilled RCx service providers



1. Helping to establish regional centers of building operations excellence and transferring training tools and material
2. Enhance and update re-tuning training materials, including web-based online interactive re-tuning training
3. Work with other deployment partners and collaborators to make the re-tuning training available more broadly

All three focus areas are targeted towards training the current and next generation of the buildings efficiency workforce

- BCTEP focuses on the intersection of buildings and construction technologies with manufacturing
- First initiative is with DOE EERE BTO and PNNL
  - Focuses on buildings and construction technologies
  - Re-tuning existing energy systems in typical commercial/industrial buildings
  - Train building operations staff in re-tuning methods
  - Expect 15-20% energy savings when completed
- Three awards made to MEP Center-led teams
  - Delaware Valley Industrial Resource Center (Penn State, Drexel, Penn College of Technology, Performance Systems Development, Facility Engineering Associates)
  - NY State Department of Economic Development (CUNY, RIT)
  - Manex (Laney College, Local 39)



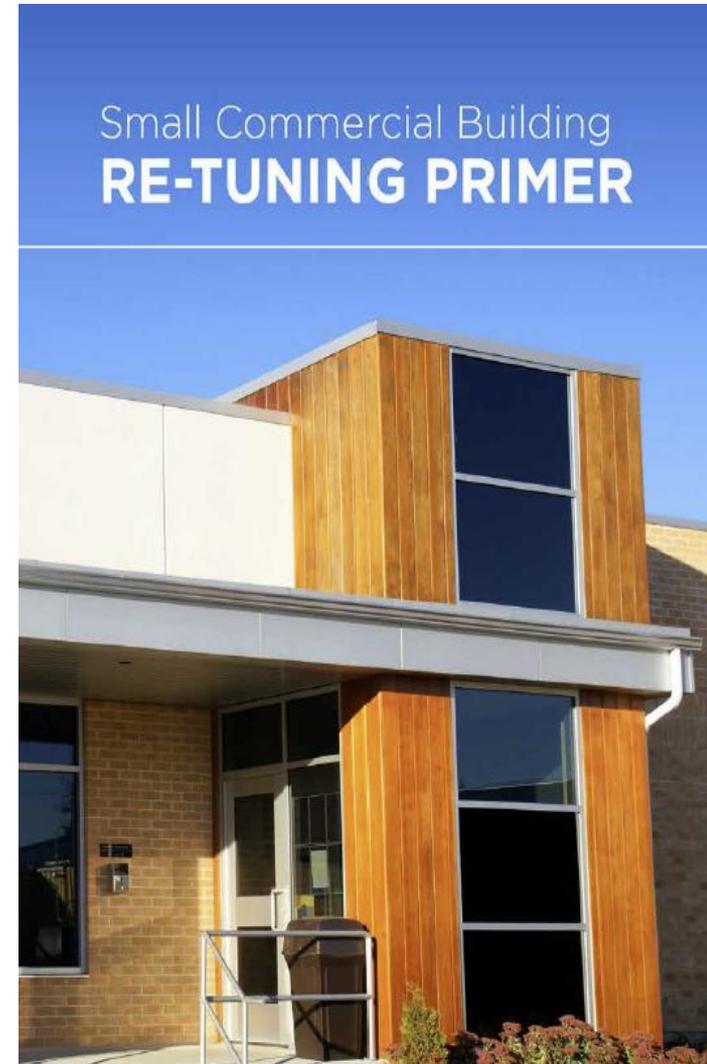
- Overall Project Management
  - Projects begun 1 Sep 2012
  - Monthly review calls individually, Quarterly collectively, Semi-annual face-to-face (21 Mar 2013)
  - Common learning objectives for buildings with and without BAS (PNNL)
  - Analysis extends to process equipment when used for both building systems and manufacturing process
  - Train-the-trainer sessions by PNNL for all 3 groups
    - BAS has been done for all within last 9 months
    - Non-BAS being scheduled for spring/early summer
  - All doing outreach to building owners/managers to identify buildings and operators
  - Using NIST MEP survey to quantify results/impacts

- DVIRC (Delaware Valley Industrial Resource Center)
  - 30 re-tuning projects; approx. 80 operators trained
  - Access to Philadelphia School District building inventory as well as Philadelphia Navy Yard, Liberty Property Trust
- NY DED (Department of Environmental Conservation)
  - 10 -15 re-tuning projects; approx. 80 operators trained plus others
  - BAS mostly in New York City; non-BAS mostly upstate
  - 16 hour program anticipated
- Manex
  - 40 hour program (16 classroom, 24 hands-on) to begin
  - Planning to add a module on refrigeration
  - Working with Pacific Gas and Electric and local WIBs to identify potential operators

- Completed a prescriptive re-tuning training and instructors manual for buildings without BAS
- Piloted this training for City of Detroit and Wayne State University building operators; also trained service providers in the Detroit area
- Working with NIST MEPs developed re-tuning curriculum learning objectives, to help convert re-tuning training into a community college course
- Completed one train-the-trainer session for the NIST MEPs

The screenshot displays the PNNL website interface for a re-tuning training module. At the top, the PNNL logo and navigation menu are visible. The main content area features a large image of a building and two workers, with the title "Re-tuning Commercial Buildings". Below this, there is a section titled "A Low-Cost Path to Energy Efficiency and Cost Savings" which includes a detailed description of the program's goals and objectives. To the right, there is an "Additional Information" sidebar with links to related resources. At the bottom, there is a "Discharge Air Temperature Scenario 1" section with a 3D model of a supply fan section and a list of inspection tasks: "Inspect supply fan", "Inspect VFD", "Check VFD belts", "Inspect motor sheaves", and "Inspect ductwork". Navigation buttons for "Return to Scene", "Back", "Help", and "Found Solution" are located at the bottom of the page.

- Planned to provide 5 additional training sessions
- Planned 2 train-the-trainer session for Office of Weatherization and Intergovernmental Program (OWIP) and State and Local Energy Efficiency Action Network (SEE Action)
- Planned one training session for Better Building Alliance members
- Started development of online interactive version of the prescriptive re-tuning training
- Started work on a re-tuning primer



# Project Plans and Schedules

Summary					Legend											
CBI_PNNL-FY13-99					Work completed											
19991					Active Task											
					Milestones & Deliverables (Original Plan)											
					Milestones & Deliverables (Actual)											
					FY2012				FY2013				FY2014			
					Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)
Task / Event	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)
<b>Transforming the Commercial Building Operations</b>																
<b>Prior Year Activities</b>																
Set up course development space on DOE's NTER development system and migrate all building re-tuning online course materials from PNNL's system		◆														
"Prescriptive re-tuning training material for small/medium-sized commercial buildings" report			◆													
"Instructor Manual: Re-tuning Large Commercial Building" report			◆													
"Train-the-trainer instructional material for all commercial buildings (large, medium and small)" report				◆												
Online interactive re-tuning learning modules & supporting material for external review				◆												
<b>Current work and future research</b>																
Re-tuning Training for Small/Medium-Sized Commercial Buildings (01/13)									◆							
Complete two small/medium building pilot re-tuning training sessions (3/13)									◆							
Re-tuning Training Train-the-Trainer Instructions for Small/Medium-Sized Commercial Buildings (4/13)																
Update small/medium building re-tuning training and train-the-trainer material based on the pilot training feedback (6/13)																
Provide technical leadership to setup the centers of excellence and input into development of enhancements to the re-tuning training (9/13)																
Participate in meeting with NIST and MEPs (9/13)																
Provide 3 to 6 re-tuning train-the-trainer sessions for MEP and their partners (9/13)																
Handbook describing the terms and technology used in the small/medium-sized building re-tuning training (9/13)																
Guideline document to help CBOEs (9/13)																
Complete at least 4 additional small/medium building pilot re-tuning training sessions (9/13)																
Deliver an online interactive re-tuning training for small/medium-sized buildings (9/13)																
Set up the large commercial building re-tuning course on DOE's National Training and Education Resource platform (12/13)																

**Project Budget:**

\$773K in FY13

**Variances:**

The project is slightly underspent because of challenges in scheduling the train-the-trainer sessions with NIST MEPs. We hope to accelerate the training sessions in Spring and Summer and meet the project milestones and deliverables

**Cost to Date:**

\$159K through 3/1/13

**Additional Funding:**

State of Washington (\$100K)

Budget History			
FY2012		FY2013	
DOE	Cost-share	DOE	Cost-share
\$362K	\$0K	\$773K	\$100K

- Past Collaborators
  - Johnson Controls, Building Operator Certification, CB Richard Ellis, Grubb & Ellis, City University of New York, City of Denver, Efficiency Vermont, Massachusetts DOE, GSA, State of Washington GA, McKinstry, BBA
- Current Collaborators
  - Three NIST MEPs and their partners, which include four technical and community colleges and a university
- Outreach and Awareness
  - Held a four part webinar for Federal Energy Management Program (FEMP) on use of Energy Charting and Metrics (ECAM) tool, which is an integral part of re-tuning buildings with BAS
  - Held a webinar for General Services Administration (GSA) on use of ECAM tool
  - Planned re-tuning webinar for MIT CoLab – Green Economic Development Initiative

- Over 1,000 registered users for online interactive re-tuning training for buildings with BAS
  - <http://retuningtraining.labworks.org/training/lms/>
- Published 10 guides that discuss re-tuning measures for buildings with BAS
  - For example, airside economizers, static pressure controls, etc.
  - [http://www.pnl.gov/buildingretuning/retuning\\_measures.stm](http://www.pnl.gov/buildingretuning/retuning_measures.stm)
- Energy Savings Modeling of Re-tuning Energy Conservation Measures in Large Office Buildings – Report
  - [http://www.pnnl.gov/main/publications/external/technical\\_reports/PNNL-21569.pdf](http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-21569.pdf)
- Transferred online re-tuning training to JCI and BOC
- Web-based online interactive re-tuning training won the 2012 APEX awards for publication excellence



- Continue to support the transfer of the re-tuning training to community colleges and private sector
- Accelerate transfer of re-tuning training to more organizations
- Work with BOC Program and the Building Owners and Managers Association to encourage them to adopt re-tuning training
- Continue to work with FEMP and GSA to promote re-tuning Federal buildings
- Write a reference book on re-tuning (for advanced users)
- Building operations is very diverse field with a number of different roles
  - Customize the online interactive training based on the role of the student taking the course
- Develop automated tools to identify operational problems as they occur
- Extend automated tools functionality to automatically correct operational problems